Undergraduate Health Care Informatics Education:
A needs analysis and proposed curriculum

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ABSTRACT

This paper describes a needs analysis and resulting curriculum in Health Care Informatics. It is implemented as a track for the BS degree within the Department of Information Systems at the University of Maryland, Baltimore County. The track in Health Care Informatics is an interdisciplinary specialty within the broader field of Information Systems which is itself an interdisciplinary field. The needs analysis shows current thinking by practitioners and educators in the new field of Health Care Informatics. It also presents a survey of undergraduate students to monitor interest in and knowledge of this field. A curriculum design is presented that addresses these needs.

INTRODUCTION

The curricula for interdisciplinary studies are difficult to design for a number of reasons, two of which are listed below:

- Student prerequisites
- Academic respect

Students face a difficult adjustment to a field that has broad and shifting boundaries. It is very difficult to get the prerequisites in all component disciplines of an interdisciplinary field and at the same time, without these, one risks dismissal by practitioners and students of each component discipline. Academic respect is a function of the previous observation. Students and faculty risk being viewed as "non-rigorous" in their approach to their field. It should be mentioned that political problems result from the financial and "turf" implications of creating a new interdisciplinary field in academia but these are beyond the scope of this paper. These realities for interdisciplinary studies are discussed below with special reference to Health Care Informatics as an undergraduate academic discipline.

Undergraduate education has the further requirement of training students broadly in a field. It is widely regarded as a mistake to specialize undergraduate studies too narrowly. This paper describes a needs analysis and resulting curriculum in Health Care Informatics. It is implemented as an optional track for the BS degree within the Department of Information Systems at the University of Maryland, Baltimore County. The track in Health Care Informatics is an interdisciplinary specialty within the broader field of Information Systems which is itself an interdisciplinary field. We are also considering a modified version of this track as a minor for majors in other disciplines.

Information Systems as an academic discipline is growing out of Computer Science and various domain areas that use information systems technology. As computer science (itself a relatively new discipline) has tried to more strictly define itself as a basic science, applications-oriented computing research suffered under tenure evaluation in many Computer Science departments. Information Systems as an academic discipline is a response to these developments. It was first made popular as a subdiscipline in the Business School as Management Information Systems. It has since become more interdisciplinary such as the department at Baltimore. The unifying theme of these information systems studies is that they are grounded in specific domains and applications of information technology. As such, it is more philosophically aligned with academic engineering schools than basic science ones.

Health care is a broad (and interdisciplinary) field that requires significant use of information technology. Furthermore, health care has special characteristics that information systems professionals need to be aware of to effectively design, develop, and implement information technology. We have developed a curriculum in Health Care Informatics that addresses these needs. The remainder of this paper describes the needs analysis for the Health Care Track in Information Systems and the details of the resulting curriculum.

NEEDS ANALYSIS

The needs analysis had two phases:

- Content analysis
- Survey of student interest and knowledge

The content analysis for the proposed track in Health Care Informatics had two components: informal interviews with educators and professionals in the field and a more formal evaluation of the proposed track by Denis Protti.

The informal interviews consisted of discussions with both information systems and health care professionals about the educational needs for undergraduates who will enter the field. These discussions targeted this undergraduate population and not dual training in information systems and a health care specialty such as nursing or medicine. The broad results of these interviews are categorized below:

- Balance technical and organizational issues
- Practical training in CO-OPs
- Keep the curriculum broad

Successful implementation of information systems in organizations is a complex set of tasks that requires many skills. Information systems are equally about communication in organizations and technical implementation. It is possible to create an information system that meets the technical requirements but fails to succeed. A mix of management, technical, and organizational behavior education is needed for Health Care Informatics. At the same time, this program is geared towards undergraduates seeking entry-level jobs. This requires a heavy emphasis on practical technical competence in the areas that are used to build health care information systems. It is a common failing in interdisciplinary fields to slight the technical issues. This is seen in many business-oriented programs in Management Information Systems where graduates learn more "why" than "how." The basic technologies that must be emphasized in Health Care Informatics are analysis and design methods, database development, and networking the organization.

Because the undergraduate education in Information Systems is not typically in a health care school, there is consensus that students must gain domain experience in health care environments. They can do this with independent studies directed by faculty in a health care school or through CO-OPs at health care institutions. CO-OPs are cooperative education programs common at universities that allow students to earn credits for work in industries relevant to their studies.

The specialty in Health Care Informatics must also be tempered with the need for undergraduate students to remain fairly flexible in their major training. They must be mainstream information systems professionals that could go into any area, but have special training and experience in health care.

Denis Protti [1] is a Professor of Health Information Science at the School of Health Information Science at the University of Victoria in Canada. He heads a program that offers the undergraduate degree in Health Informatics. This degree is the first of its kind and their experience with the degree was considered valuable for our program. Dr. Protti came to the University of Maryland to evaluate our proposed curriculum. He supported the informal results given above and refined these ideas. Dr. Protti emphasized that the information links and flow patterns in health care are more complex than those found in business and that the graduates in Health Care Informatics need to be prepared to deal with this complexity. "What distinguishes health care paths of information from others is the high intensity and responsiveness required of information in the horizontal dimension, particularly in matters concerning patient information." [2] He also corroborated the need for practical student experience in CO-OPs. He observed that the specialty training in Health Care Informatics increases the probability that our graduates would be successful change agents in health care in the United States.

The second phase of the needs analysis consisted of a survey to measure the interest and general knowledge about health care informatics of undergraduates at the University of Maryland, Baltimore County (UMBC). We developed two surveys: one for current majors of Information Systems and one or majors in other areas. The survey for Information Systems majors was to measure interest in the proposed track and the non-major survey was to measure interest in a (non-implemented) minor in Healthcare Informatics. Information Systems is the largest major on this campus with approximately 700 undergraduate students.

Each survey consisted of 15 questions and was administered by the instructor of a course during class time. The surveys were designed to show the level of interest in Health Care Informatics in a general way to aid in designing the track. Responses are reported for a subset of the questions below. The surveys were given only to upper division undergraduate students.

350 survey questionnaires were distributed to UMBC students with the following distribution of majors:

Biology/(Bio-)Chemistry	87
CS/Engineering	10
Information Systems	46
Psychology	42
Unknown/Other	54
Total	**239**

Of the 239 respondents 88 were males and 131 were females (with 20 unreported genders). The reasons for non-response were not captured. Responses for the following subset of questions are reported for *Information Systems* (IFSM, n=46) majors:

1. Do you consider yourself to have a content area specialty in your major? (y/n)

2. Would you be interested in a track in IFSM that allowed you to specialize in a field such as scientific computing or health care? (y/n/maybe)

3. The study of information systems in health care is often called Health Care Informatics. Do you think this is important to your major in IFSM? (y/n/maybe)

4. Would you be interested in a track in Health Care Informatics that allowed you to specialize your IFSM major? (y/n/maybe)

5. Do you think that you may get a job related to health care? (y/n)

Q#	yes	no	maybe	no response
1	24	21		1
2	17	7	22	0
3	23	14	9	0
4	9	17	20	0
5	12	33		1

IFSM majors only report having a domain area specialty about 52% (24/46) of the time. The survey went on to determine that the majority of these students reported business as their specialty. 85% (39/46) of the students wanted a specialty or wanted more information on them. 67% (31/46) of the IFSM students were possibly interested in Health Care Informatics and 63% (29/46) were interested in a formal track (or more information on it) for the major. Finally, 26% (12/46) of the students thought that they would get a job related to health Care. These results indicate that there is interest in the student population of Information Systems majors for education in Health Care Informatics.

Responses for the following subset of questions are reported for *Other*(non-IFSM, n=193) majors:

1. How important do you think computers and information systems are to your field? (y/n/maybe)

2. Are you interested in studying information systems applications in your major field? (y/n/maybe)

3. Would you be interested in a minor in information systems that allowed you to specialize in your major field? (y/n/maybe)

4. The study of information systems in health care is often called Health Care Informatics. Do you think this is important to your major field? (y/n/maybe)

5. Do you think that you may get a job related to health care? (y/n)

Q#	yes	no	maybe	no response
1	168	3	21	1
2	154	34	0	5
3	65	54	73	1
4	114	26	51	2
5	139	47		7

In the case of non-IFSM majors, 87% (168/193) of the students reported that information systems were important to their major field. 80% (154/193) of the students wanted to combine their major field with the study of information systems. 34% (65/193) were interested in a minor in Information Systems. 59% (114/193) of them thought that Health Care Informatics was important to their major field and 72% (139/193) thought they might get a job related to health care. The large number of students in Biology and (Bio-)Chemistry is probably responsible for the interest.

These results are encouraging not only for a minor in Health Care Informatics but for the general idea that one could obtain a minor that allowed information systems study that was tailored to the student's major field of study. The sample was too small and the survey conditions too uncontrolled to be able to stratify the results by major area etc.

CURRICULUM

Based on the needs analysis, we designed a curriculum that allowed an undergraduate specialty in Health Care Informatics with broad training in Information Systems. The curriculum is shown in detail in Appendix 1. The content of each class is generally obvious from the title. The health care specific classes include a year long course in Health Care Informatics, an independent study or CO-OP, a course in Health Economics, and one in the Politics of Health (Policy). The first course in Healthcare Informatics follows a departmental or intra-organizational view with sections on particular areas in the health care enterprise (lab, nursing, CPR, etc.). The second course takes an inter-organizational view with an emphasis on network communications and

policy (CHINs, payment, research repositories, etc.). The track is approved and begins in the Fall of 1994.

This curriculum balances organizational issues with technical ones, includes practical training in health care environments, and remains a broad program within Information Systems. It can serve as training for Information Systems professionals who typically go on for a masters degree or a pre-professional program for students wishing to enter health care post-graduate study [3]. Ball [4] has suggested a classification for Health Informatics curricula as:

- Health-based curricula
- Informatics-based curricula
- Dedicated and integrated curricula

Each of these types of curricula have an important place in graduate and undergraduate education. The health-based curricula are deployed primarily as components of professional education in health care such as the Nursing Informatics program at the University of Maryland. Dedicated and integrated curricula have equal emphasis on the health domain and the information systems theory and technology. These are also typically graduate programs such as the MS/PhD in Medical Informatics at the University of Utah. The informatics-based curricula (such as this one) are particularly relevant to undergraduate education since they allow broad education in information systems and exposure to the domain of health care. (The authors would like to acknowledge the work of Tony Norico and Marion Ball for help in developing this curriculum.)

CONCLUSIONS

The needs analysis reported here shows a coherent rationale for an undergraduate track in Healthcare Informatics within a major in Information Systems. The survey component of this analysis shows acceptable demand from the student population. In addition to majors in Information Systems, majors from other areas show interest in applying the study of Information Systems to their own major field of study. This squares nicely with the vision of Information Systems as a domain area-based field of study. The field tries to balance technical and organizational/management study to produce practitioners that will be more successful in designing, developing, and implementing information systems for enterprises.

The curriculum developed from this needs analysis for Health Care Informatics addresses the issues of breadth in information systems and practical experience in health care. This curriculum places Health Care Informatics in the mainstream of the field of Information Systems to reduce the problems associated with class pre-requisites and academic respect. There is definitely an important place for informatics education in the curricula of the health care professions, but due to time constraints, it is very difficult to become a true health information systems professional in the course of a graduate clinical education.

Reference

[1]. Protti, D., C. Anglin, The continuum of health informatics education: Where do existing curricula fit?, MEDINFO92, K. Lun et al. eds., Amsterdam:North-Holland, 1992, pp1066-1071.

[2]. Protti, D., Personal Communication, 1993.

[3]. Ranum, D., "Pre-Medical" Informatics, 17th SCAMC, C. Safran ed., 1993, pp743-746.

[4]. Ball, M., J. Zimmerman, Informatics Education and the Professions, *J. Am. Soc. Inf. Sci.* 40 1989, pp.368-377.

APPENDIX 1
Health Care Informatics Track
27 Hrs in Information Systems

IFSM 202—Systems Analysis Methods
IFSM 310—Software and Hardware Concepts
IFSM 410—Database System Development
IFSM 420—Advanced Database Concepts
IFSM 436—Structured Systems Analysis & Design
IFSM 460—Health Care Informatics I
IFSM 461—Health Care Informatics II
IFSM 468—Project in Health Care Informatics
and one of:
IFSM 450—Data Communications and Networks
IFSM 425—Decision Support Systems
8 Hrs in Computer Programming

CMSC 201—Computer Science I for Majors
CMSC 202—Computer Science II for Majors
18 Hrs in Economics and Management

ECAD 210—The Practice of Management
ECON 101—Principles of Economics I
ECON 102—Principles of Economics II
ECON 467—Health Economics
POLI 452 —The Politics of Health
ENGL 393—Technical Writing
13 Hrs of Mathematics and Statistics

MATH 151—Calculus and Analytic Geometry I
MATH 221—Introduction to Linear Algebra
IFSM 300—Introduction to Management Science
STAT 351—Applied Statistics